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ABSTRACT

This paper reviews the history of the GLOBE (Global Learning and Observations to Benefit the Environment) Program, an international environmental science education program. The goals of the program are to: enhance the environmental awareness of individuals around the world; contribute to the scientific understanding of the earth; and to help all students reach higher levels of achievement in science and mathematics. GLOBE engages K-12 students and scientists in collecting and analyzing data and represents a true partnership between the science and education communities. The nature of this partnership is reflected in the various research protocols and learning activities used at each grade level. The science processes used by researchers reflect the inquiry process used at the K-12 or equivalent level. The GLOBE curriculum is divided into investigation areas on atmosphere, hydrology, biology/land cover, soil and the global positioning system (GPS). (DDR)

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GLOBE:
A Science/ Education Partnership Program

by
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GLOBE: A Science/Education Partnership Program

A Paper presented at the Annual AERA meeting, Chicago, IL 1997
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The GLOBE Program, Global Learning and Observations to Benefit the Environment, is an international environmental science education program. The program's three goals are to: 1) enhance the environmental awareness of individuals throughout the world, 2) contribute to the scientific understanding of the Earth, and 3) help all students reach higher levels of achievement in science and mathematics. GLOBE was announced on April 22, Earth Day, 1994 by Vice President Al Gore. The genesis of the program came from the book he had written earlier as a senator called *Earth in the Balance*. In his book, he called for K-12 students all around the world to acquire data for scientists helping them complete gaps in various data sets and assisting in the creation of new data sets. The students would receive feedback from the scientists in various forms. In GLOBE, the data are used by scientists for their research while students are also utilizing them in their research and in this way learning the scientific process.

Introduction: During the summer of 1994, a number of meetings were held with scientists and educators to identify potential scientific measurements for K-12 students. Discussions ensued as to whether K-12 students could collect valid and reliable data for the scientific community. Any scientific measurements that were proposed should meet the following three criteria: (1) be interesting to students and valuable to the scientific and education communities; (2) be as simple as possible, grade appropriate and clearly described; and (3) have reasonably priced scientific equipment.

Scientific protocols were developed from this first set of meetings and training in these protocols began in 1995. When the original set of nine protocols were developed, educational materials to accompany the protocols were adapted from existing environmental materials. At the workshops, teachers received a kit which included a GLOBE Program Teacher's Guide and additional instructional aids to assist educators teach their students the protocols. Capabilities were developed which allowed data to be reported over the internet on World Wide Web forms. (For schools in partner countries, email data entry has been developed as an added method of reporting data.) Beginning on April 22, 1995, the first data were reported from schools with GLOBE teachers. Students received as feedback vibrant images, called visualizations, of their data and had access to

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the raw data of the reporting GLOBE schools. The visualizations continue to be enhanced on a regular basis to increase their utility to teachers and students.

In late 1994, a new announcement of opportunity for a second set of scientific protocols and associated learning materials was released. The selected teams of scientists and educators began developing new protocols and learning materials in late 1995. Some of the new protocols and learning activities were introduced in the summer of 1996 in the new style modularized GLOBE Program Teacher's Guide. On Earth Day 1997 more advanced, elaborate and dynamic visualizations were added to the system. An additional capability of this system is the ability to graph all the data from a school or compare two schools for a specific environmental parameter measured by GLOBE students. As of mid-1997, over 600,000 data reports have been entered to the freely-accessible web archive. Over 55 countries are involved in the program, each implementing GLOBE in a way that is consistent with their education system. Additional protocols and learning activities were introduced during the summer of 1997.

To attain the three goals of GLOBE, the science and education aspects of the program each have separate but interrelated objectives. These are outlined below.

Science Objectives: The scientific objective of GLOBE is that the program will ensure that GLOBE student scientists are contributing accurate and reliable data to the scientific community. To facilitate this process, GLOBE has selected Science Teams in each discipline area (Atmosphere, Hydrology, Land Cover/Biology, and Soil) to: 1) identify GLOBE science topics and measurements; 2) establish GLOBE measurement protocols; 3) specify GLOBE instruments; 4) determine the criteria for site selection and instrument placement; 5) support training for GLOBE teachers, who guide their students in making the measurements; 6) develop quality control procedures for data archiving, and 7) provide feedback to students and teachers. In addition, students use GPS (Global Positioning System) equipment to tag their data to a specific latitude and longitude so that scientists can accurately pinpoint the data acquisition location. As a result of their involvement in the program, GLOBE students measure components of the Earth system and its cycles.

Education Objectives: The educational objectives of GLOBE are that the program: 1) enrich students' understanding of the environment and appreciation of the concepts and processes of science; 2) promote the development of critical thinking skills by providing analytical tools for use with measurement data; 3) facilitate mentoring partnerships between scientists and

students in order to enhance students' understanding and appreciation of science and also to provide positive and diverse role models; 4) allow students to put their local understanding of science and the environment into a global perspective; and 5) enable communication and cooperation among students and teachers worldwide to advance both global environmental awareness and cultural awareness.

The science and education objectives are clearly exemplified in the GLOBE Program Teacher's Guide. The guide is divided into a number of modules or investigation areas including Atmosphere, Hydrology, Biology/Land Cover, Soil, and GPS. These were developed by the appropriate scientist and educator teams. Each investigation contains the specific scientific protocols and appropriate learning activities which link science and education. The protocols, by focusing on data acquisition and reporting, enable participation in the scientific process and contribution to research and generation of knowledge about the Earth as a system. The learning materials represent the full spectrum of the inquiry process by expanding the data acquisition and reporting processes, thus facilitating the understanding of science. They also promote school to school communication through internet technology. Specific activities reinforce the importance of data quality and accurate data acquisition. In this way, the GLOBE science and education processes are represented in both the protocols and the learning activities within the guide and are mutually reinforcing (see Figure 1).

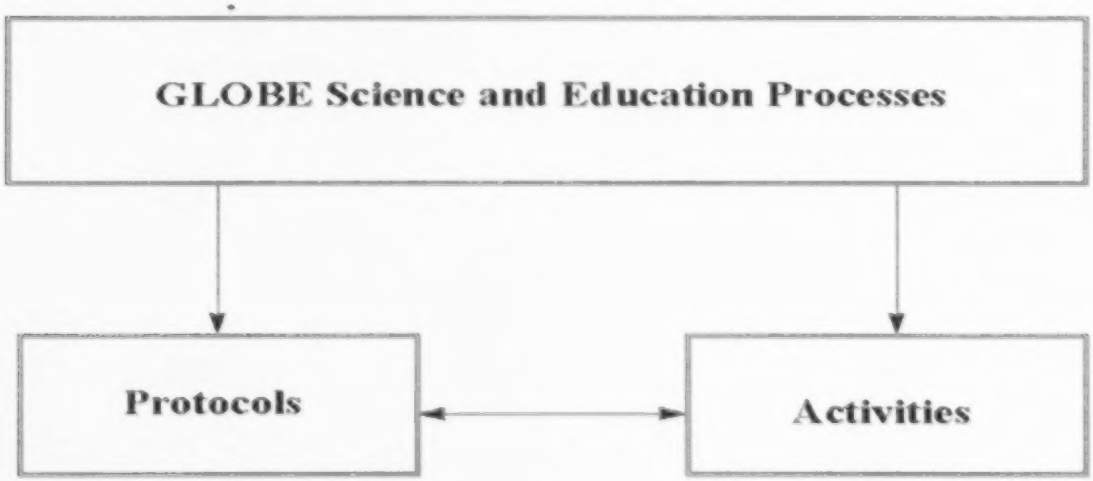

Figure 1. GLOBE Science and Education Processes are reflected in the protocols and learning activities, which are also mutually reinforcing.

GLOBE: A Partnership Between Science and Education: GLOBE is truly a partnership between science and education as reflected in the protocols and learning activities. The science process used by researchers is a reflection of the inquiry process used at the K-12 or equivalent level (Figure 2).

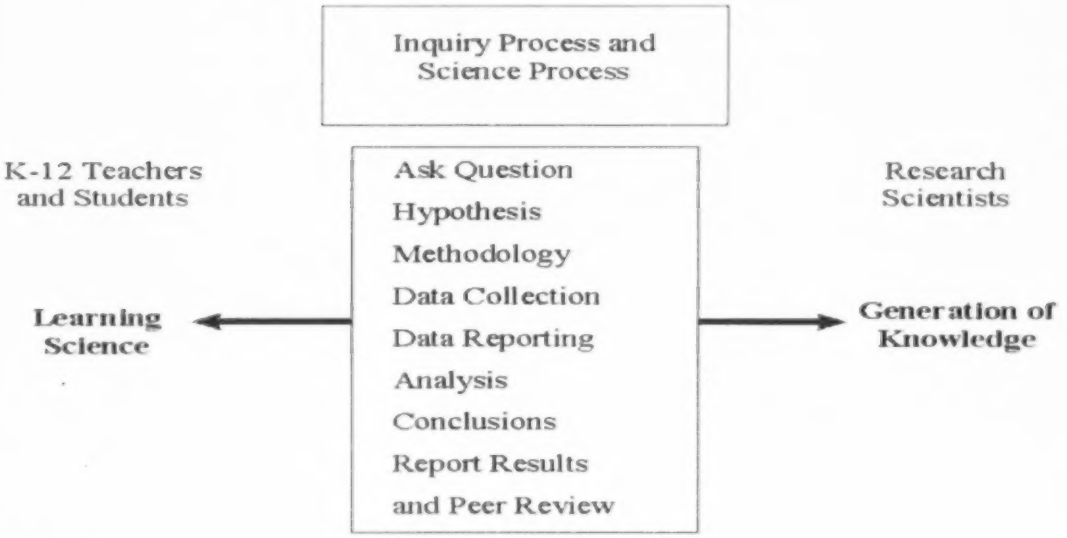

Figure 2. GLOBE Inquiry and Science Processes, illustrating the connection between the K-12 education community and research scientists.

The primary difference is the outcome at each level: in K-12 education community the outcome is learning science, while at the research level the outcome is the generation of new knowledge. These processes are also connected through the data acquisition/reporting by the students/teachers to the scientific research community, and by the feedback of visualizations and research results to the school from the scientists. In addition, GLOBE schools are encouraged to communicate together, collaborating on research projects and learning activities through a system know as GLOBEMail. This facility allows GLOBE schools with web access in any location to connect with each other on scientific as well as other topics.

For further information on the GLOBE Program, contact (800) 858-9947, email: <info@globe.gov> or visit the web site at <www.globe.gov> Visitors to the web site can access all of the functions except data entry and contacting GLOBE schools.

Current GLOBE Protocols (7/97)

Atmosphere Investigation

Max./Min./Current Air Temp
Liquid Precipitation
Solid Precipitation (Total and Daily Accumulation/Water Equivalent)
Cloud Cover/Cloud Type
Precipitation pH

Hydrology Investigation

Transparency
Temperature
Dissolved Oxygen
pH
Conductivity
Salinity
Alkalinity
Nitrate

Land Cover/Biology Investigation

Land Cover Mapping (MUC (Modified UNESCO Classification) Scheme)
Ground Observations and Biometry (ID of Dominant and Co-Dominant Species, Canopy and Ground Cover, Tree Height, Tree Circumference, Grass Biomass)
Quantitative and Qualitative Data Collection
Accuracy Assessment

Soil Investigation

- Characterization
- Moisture
- Temperature
- Infiltration
- Particle Size Distribution
- Bulk Density
- pH
- Fertility

GPS at all sites used by the students